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**Report Title**

Final Report on the Standing Committee on Defense Materials, Manufacturing,  
and Infrastructure

**ABSTRACT**

See attachment

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**Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:**

**(a) Papers published in peer-reviewed journals (N/A for none)**

<u>Received</u>	<u>Paper</u>
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**TOTAL:**

**Number of Papers published in peer-reviewed journals:**

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**(b) Papers published in non-peer-reviewed journals (N/A for none)**

<u>Received</u>	<u>Paper</u>
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**TOTAL:**

**Number of Papers published in non peer-reviewed journals:**

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**(c) Presentations**

**Number of Presentations:**      0.00

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**Non Peer-Reviewed Conference Proceeding publications (other than abstracts):**

Received

Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

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Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received

Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

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(d) Manuscripts

Received

Paper

TOTAL:

Number of Manuscripts:

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Books

Received

Paper

TOTAL:

Patents Submitted

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## Patents Awarded

### Awards

#### Graduate Students

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
-------------	--------------------------

FTE Equivalent:

Total Number:

#### Names of Post Doctorates

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
-------------	--------------------------

FTE Equivalent:

Total Number:

#### Names of Faculty Supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
-------------	--------------------------

FTE Equivalent:

Total Number:

#### Names of Under Graduate students supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
-------------	--------------------------

FTE Equivalent:

Total Number:

#### Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: ..... 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense ..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields: ..... 0.00

**Names of Personnel receiving masters degrees**

<u>NAME</u>
<b>Total Number:</b>

**Names of personnel receiving PHDs**

<u>NAME</u>
<b>Total Number:</b>

**Names of other research staff**

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
Erik Svedberg	0.11
Lynda Stanley	0.02
Ricky Washington	0.05
Laura Toth	0.10
Heather Lozowski	0.06
<b>FTE Equivalent:</b>	<b>0.34</b>
<b>Total Number:</b>	<b>5</b>

**Sub Contractors (DD882)**

**Inventions (DD882)**

**Scientific Progress**

**Technology Transfer**

# **FINAL TECHNICAL REPORT**

**Standing Committee on Defense Materials, Manufacturing,  
and Infrastructure**

**Interim Progress Reporting  
Proposal Number: 58493-MS  
Agreement Number: W911NF-10-C-0098**

**Period 1/1/10 - 6/30/11**

**THE NATIONAL ACADEMIES**  
*Advisers to the Nation on Science, Engineering, and Medicine*

## **Standing Committee on Defense Materials, Manufacturing, and Infrastructure**

**Statement of Task:** The National Research Council has established a standing committee to convene periodic meetings to discuss topics concerning defense materials, manufacturing, and infrastructure. In meetings to be held approximately three times per year with sponsors and selected speakers, the committee will become informed of emerging issues, discuss planning and program development efforts, and serve as a focal point for potential ad hoc studies and other activities. The committee and its sponsors will jointly agree to the topic, and the invited speakers, for each individual meeting.

**Project Context and Issues:** The Department of Defense will need to address a range of systems-based, complex problems in the coming years. This standing committee will address significant issues regarding materials, manufacturing, and infrastructure-related activities. Such issues require a technical basis in order to explore the emerging scientific and technological opportunities and to inform policy decisions. Issues to be discussed will emanate from a military focus on personnel, platforms, facilities and manufacturing/industrial base, with transfer of relevant technologies to the commercial sector as appropriate. These issues will require an understanding of the interactions among materials, manufacturing and infrastructure which include, but are not limited to: maintaining technological superiority; creating energy efficient, high performance and sustainable platforms; assuring a safe, healthy, and energy efficient infrastructure; securing the safety of facilities and ports and assessing the critical availability and timeliness of the processes that provide defense materials, parts, and products. Informed approaches to addressing these issues, although assessed from a defense focus, will enable the nation to more effectively sustain technological leadership, as well as to maintain safety of people within federal and private facilities, enhance the infrastructure, and improve the manufacturing base.

**Project Audiences and Impact:** The audience will be agency sponsors and others interested in the individual meeting topics. The project will be a continuing interactive relationship between the standing committee and the sponsors and provide the basis for prospective studies and other activities at the National Research Council. The activity will not produce any reports or result in any advice or recommendation.

**Standing Committee:** The standing committee members will have expertise in materials, systems engineering, supply chain logistics, infrastructure, manufacturing; defense-centered industrial base, facilities and operations, defense procurement, and technology transfer. They will engage in planning, program development, and (as appropriate) oversight of activities under its auspices. The standing committee will operate under the aegis of the National Materials Advisory Board (NMAB) with support from the Board on Manufacturing and Engineering Design (BMED), and the Board on Infrastructure and the Constructed Environment (BICE). The standing committee members and their biographies follow.

## **Activities;**

During the first year of the DMMI standing committee there was 2 meetings held. Meeting 1, was held on November 4-5, 2010 and Meeting 2, on March 31 – April 1, 2011. See appendix 3 for the agendas. The first meeting resulted in the set of initial project descriptions as seen in appendix 4 while the second meeting had the following meeting objectives; *Discussions on Materials and Manufacturing Sustainability*. This meeting includes infrastructure considerations, efficient and green processing and manufacturing aspects as well as materials availability. Focus is on materials availability problems, critical minerals, rare earths, substitution, recycling etc., materials processing capabilities, shortcomings etc., manufacturing and infrastructure.

## **Appendices:**

### *Appendix 1*

Describes the context of the DMMI

### *Appendix 2*

Lists the standing committee members and their short bios.

### *Appendix 3*

List the two meetings held

Meeting 1, November 4-5, 2010

Meeting 2, March 31 – April 1, 2011

### *Appendix 4*

Initial project descriptions

Appendix 4 lists the individually suggested topics for future DMMI meetings. These were prepared for discussion purposes only, they have not been reviewed. The views expressed do not necessarily reflect the views of the National Research Council or the standing committee on Defense Materials, Manufacturing and Infrastructure (DMMI) as a whole.

# Appendix 1

## Context;

### **Standing Committee on Defense Materials, Manufacturing, and Infrastructure**

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## Appendix 2

### Standing committee members, short bios;

**Robert H. Latiff, Chair**, is President of R. Latiff Associates and chair of NMAB. Previous to this he was Vice President, Chief Engineer and Technology Officer in SAIC's Space and Geospatial Intelligence Business Unit. He retired in 2006 from the US Air Force as a Major General, with his last assignments at the National Reconnaissance Office as the Director for Systems Engineering and as the Director of Advanced Systems and Technology. General Latiff was a career technologist and acquisition officer, managing large and complex systems such as the Cheyenne Mountain Upgrade, the Air Force's airspace management and landing systems, and the Joint Surveillance Target Attack Radar System (JSTARS). He also served as Commander, Cheyenne Mountain Operations Center and Vice Commander, Air Force Electronic Systems Center. Dr Latiff has served as committee member or task force member for the Air Force Studies Board and the Defense Science Board. He is an Adjunct Professor of Applied Information Technology at George Mason University. Dr Latiff holds a MS and PhD in Materials Science and a BS in Physics from the University of Notre Dame.

**Robert E. Schafrik** is currently the General Manager, Materials and Process Engineering Department at GE Aviation and a NMAB board member. He is responsible for developing advanced materials and processes used in GE's aeronautical turbine engines and their marine and industrial derivatives. He oversees Materials Application Engineering activities supporting GE Aviation's global design engineering, manufacturing, and field support activities. He also operates a state-of-the-art in-house laboratory for advanced materials development, characterization, and failure analysis. Prior to joining GE in November 1997, he served in 2 concurrent positions within the National Research Council, which he joined in 1991: Staff Director, National Materials Advisory Board and Staff Director, Board on Manufacturing and Engineering Design. Under his direction, 33 final reports for studies were issued that addressed significant national issues in materials and manufacturing. Dr. Schafrik also served in the U.S. Air Force in a variety of R&D and system acquisition capacities; he retired as a Lieutenant Colonel. He has a Ph.D. in metallurgical engineering from Ohio State University, an M.S. in information systems from George Mason University, an M.S. in aerospace engineering from the Air Force Institute of Technology, and a B.S. in metallurgy from Case-Western Reserve University.

**Haydn N. G. Wadley** is the Edgar Starke and University Professor of Materials Science at the University of Virginia in Charlottesville, Virginia and a NMAB board member. He has very broad interests in materials science. His current research explores high temperature thermal protection systems (thermal barrier coatings, liquid metal heat plates for hypersonic vehicle leading edges) and new materials for the mitigation of high intensity dynamic loads. He has addressed many fundamental questions associated with the atomic assembly of nanoscopic materials from the vapor phase, the topological structuring of cellular materials and the processing of high performance composites. These fundamental studies have been used to develop models and numerical simulations that expose the linkages between a materials composition/synthesis and its performance. Some of these models have been coupled with in-situ (ultrasonic and electromagnetic) sensors and nonlinear, feedback control algorithms to implement intelligent process control concepts. He has invented and commercialized several vapor deposition technologies that enable the growth of novel thin films and coatings, and numerous multifunctional cellular materials including those that support stress whilst also serving as impact energy absorbers, heat exchange media, electro-chemical power storage systems or shape morphing structures. He has published 393 papers, co-authored a book on cellular materials, holds 13 US patents, is a fellow of the American Society for Materials and the recipient of several awards. Dr Wadley has spent many years helping the Department of Defense to identify new technology development opportunities in areas as diverse as the

exploitation of space and humanitarian relief operations. Haydn Wadley received his bachelor's degree in Chemical Physics and his PhD in Physics from the University of Reading (UK). Prior to joining the University of Virginia in 1988 he was a senior scientist at the National Institute of Standards and Technology and a leader of its advanced sensors group. He began his research career at the Atomic Energy Research Establishment (Harwell) where he worked on the origins of acoustic emissions in materials and radiation damage mechanisms in refractory metals.

**Steven G. Wax** is a technology consultant specializing in defense research and development and a NMAB board member. He is supporting Defense clients in strategic planning and technology innovation across a range of scientific and engineering disciplines including the physical sciences, materials, biology, biomedical, and mathematics. Prior to executive level positions at Strategic Analysis, Inc and SRI, International, Dr. Wax spent 35 years working for the Department of Defense as a civilian and a military officer. During that period, he performed and managed Government R&D across a broad spectrum of classified and unclassified technology areas. His last Government position was as Director of the Defense Science Office, DARPA, a \$400 million per year office whose technology purview included physical sciences, materials, mathematics, human effectiveness, and the biological sciences including biological warfare defense. As director, Dr Wax was responsible for the office's investment strategy as well as the transition of office technologies to the military. Previous Government positions also include deputy director of the Technology Reinvestment Project and an assignment to the National Reconnaissance Office. Dr. Wax is currently a member of the National Materials Advisory Board and past member of Sandia National Laboratory's External Review Panel for Materials. He recently served as an external reviewer of ONR's Discovery and Innovation portfolio. He is also a member of the AFRL's Human Effectiveness Directorate's independent Review Team. He was the winner of the George Kimball Burgess Memorial Award in 2009. Notable technical accomplishments include a major role in the development of the Defense Advanced Research Projects Agency's (DARPA) strategic plans for both biology and material science as well as the co-development of two material science program thrusts (Intelligent Processing of Materials and Accelerated Insertion of Materials) that have revolutionized materials processing and insertion. He has also supported work in such diverse areas as ceramics, ceramic composites and fibers, electroactive polymers, materials processing, space materials and systems, advanced batteries and personnel armor. Dr. Wax has a PhD in Ceramic Engineering from Georgia Institute of Technology, an MS, Chemical Engineering from the University of Illinois and a BS in Chemical Engineering from the University of Massachusetts. Dr. Wax is a retired Air Force Officer.

**Valerie Browning** is an independent consultant and subject matter expert for ValTech Solutions, LLC and a NMAB board member. She serves as a subject matter expert for a number of DoD and other government activities in the areas of advanced materials and alternative energy. Prior to forming ValTech Solutions, LLC in December 2007, Dr. Browning served as a Program Manager in the Defense Sciences Office at the Defense Advanced Research Program Agency. During her tenure at DARPA, she assumed full responsibility for the strategic planning, operating management, leadership and development of multiple R&D programs providing innovative technologies in power and energy, radar, telecommunications, and biotechnology for diagnostics, therapeutics and chem./bio warfare defense. Specific programs managed by Dr. Browning include the MetaMaterials, Palm Power, Direct Thermal to Electric Conversion, Negative Index Materials, Robust Portable Power Systems, and BioMagnetic Interfacing Concepts Programs. She also served as the DARPA liaison to the DoD IPT on Energy Security and served as Acting DSO Office Director prior to her departure from government service. In addition to her time at DARPA, Dr. Browning spent 16 of her 24 years of government service as a research physicist at the Naval Research Laboratory. Her primary areas of research were thermoelectric materials, high temperature superconductors and magnetic oxide materials. Upon leaving her government

position, Dr. Browning was awarded the Secretary of Defense Award for Outstanding Public Service. She has published over 40 peer review manuscripts including three book chapters. She is active in a number of professional organizations including the American Physical Society, the Materials Research Society, and Sigma Xi. Most recently, Dr. Browning served as co-chair for a 2007 MRS Symposium on magnetic materials and was the Technical Program Committee Chair for the 2008 Fuel Cell Seminar.

Born in South Ruislip, England, Valerie is a 1987 graduate of Virginia Tech where she received her B.S. in physics. She also holds a M.S. in physics from the University of Maryland and a Ph.D. in physics from the Catholic University of America.

**George T. Gray, III** is a Laboratory Fellow and staff member in the dynamic properties and constitutive modeling team within the Materials Science Division of Los Alamos National Laboratory and a NMAB board member. He came to LANL following a three-year visiting scholar position at the Technical University of Hamburg-Harburg in Hamburg, Germany having received his PhD in Materials Science in 1981 from Carnegie-Mellon University. As a staff member (1985-1987) and later team leader (1987-2003) in the Dynamic Materials Properties and Constitutive Modeling Section within the Structure / Property Relations Group (MST-8) at LANL, he has directed a research team working on investigations of the dynamic response of materials. He conducts fundamental, applied, and focused programmatic research on materials and structures, in particular in response to high-strain-rate and shock deformation. His research is focused on experimental and modeling studies of substructure evolution and mechanical response of materials. These constitutive and damage models are utilized in engineering computer codes to support large-scale finite element modeling simulations of structures ranging from national defense (DOE, DoD, DARPA), industry (GM, Ford, Chrysler, and Bettis), foreign object damage, and manufacturing. He is a Life Member of Clare Hall, Cambridge University where he was on sabbatical in the summer of 1998. He co-chaired the Physical Metallurgy Gordon Conference in 2000 and currently serves on the Board of Directors of TMS as the chair of Publications. He is a Fellow of the American Physical Society, Fellow of ASM International, a member of APS, ASM, TMS, and serves on the International Scientific Advisory Board of the European DYMAT Association. He serves on the Acta Materialia Board of Governors. He is currently the Vice-President of the Minerals, Metals, and Materials Society (TMS). He has authored or co-authored over 330 technical publications.

**Denise F. Swink** is retired from Federal Service (2004) after 35 years experience spanning a variety of programs at the U.S. Geological Survey, the U.S. Environmental Protection Agency and the U. S. Department of Energy, and is currently serving as a consultant to private sector and non-profit organizations, she is also a BMED board member. At the Department of Energy, Ms. Swink held positions as Director, Office of Planning and Environment, Office of Fossil Energy; Deputy Assistant Secretary, Office of Industrial Technologies, Office of Energy Efficiency and Renewable Energy; and Deputy Director and Acting Director, Office of Energy Assurance. The last two decades Ms. Swink held management/supervisory positions, and the last decade she was a member of the Senior Executive Service. Ms. Swink has worked at the highest levels of government, both nationally and internationally, on topics including: fossil energy technology advancement for extraction, transport and utilization of resources; manufacturing productivity and efficiency with emphasis on technology advancement and adoption; electricity infrastructure development; and safety and reliability of the entire energy infrastructure. To enhance the efficiency and competitiveness of industry, Ms. Swink created and lead extensive public/private partnerships (with state and academic) entities to develop strategies promoting innovation, fund and implement plans and monitor results and effectiveness. As the energy infrastructure is the bedrock infrastructure for the reliability of all other critical infrastructures, Ms. Swink has

substantial knowledge of interdependencies among infrastructures such as banking and finance, telecommunications, water systems, agriculture and manufacturing operations. She holds an undergraduate degree in Mathematics and Masters Degree in Environmental Sciences. Ms. Swink has been recognized in her career by several industry sponsored awards, the Department of Energy Gold Medal, the U.S Environmental Protection Agency Bronze Award, and the Senior Executive Presidential Rank Award. Ms. Swink is currently, also, a Senior Advisor to the Council On Competitiveness, focusing on building the Business Case for Resilience, much as was done for quality and safety over the past decades.

**Thomas S. Hartwick** is retired from general management in the aerospace industry and a NMAB board member. He has more than 50 years of research and development, technology transfer/insertion, and mainstream business experience supporting all segments of the U.S. government, he is also a BMED board member. Dr. Hartwick previously worked at Hughes Aircraft Company, Aerospace Corporation and TRW. General management positions include electro-optic R&D laboratories, chip R&D and manufacturing, corporate strategic planning, a commercial chip company, and a major satellite payload program. His areas of published research include sensors and imaging, optical communications, magnetic materials, microwave devices, molecular lasers, far-infrared lasers and their applications, and laser heterodyne radiometry. Since leaving the aerospace industry in 1995, Dr. Hartwick has served on a number of academic, government, and industrial boards in a technical management role. He is past Chairman (Emeritus) of the Advisory Group on Electron Devices for Office of Sec Def, Chair of NRC committees on Aviation Security R&D, active with the Defense Science Board and GAO, and active for two decades with the National Technology Transfer Center. He currently serves on 5 corporate boards/committees. Dr. Hartwick received his Ph.D. in electrical engineering from the University of Southern California, his M.S. in physics from UCLA, and his B.S. in physics from the University of Illinois. He holds a Top Secret clearance for service on AFSAB, DSB, AGED, ARL, AFRL, NSA and other committees. He is also an advocate for on-shore DOD chip production and reviewer of AFRL organization, materials and manufacturing activities. Among Dr. Hartwick's expertise is also hands-on experience in strategic planning, marketing, manufacturing, business acquisition and licensing, and congressional interactions. He has advised over 700 public and private companies for MDA.

**Michael F. McGrath** is Vice President of Analytic Services Inc. (ANSER), a not-for-profit public service research institute and a BMED board member. He leads ANSER's operations in the Science and Technology, Enterprise Systems and Planning, and Operations Analysis and Management market sectors. Prior to joining ANSER in 2007, he served as Deputy Assistant Secretary of the Navy for Research, Development, Test, and Evaluation. His prior industry experience includes five years as Vice President for Government Business at the Sarnoff Corporation, a leading R&D company with both commercial and government clients. His prior government experience includes a career that progressed in reverse life cycle order, starting with logistics at NAVAIR in the 1970s, acquisition at Office of the Secretary of Defense (OSD) in the 1980s, and Science and Technology at DARPA in the 1990s. As DARPA's assistant director for manufacturing, he managed programs in Agile Manufacturing, Electronic Commerce Resource Centers, and Affordable Multi Missile Manufacturing. He also served in leadership positions for several DoD-wide initiatives to improve manufacturing and reduce the cost of defense systems, including an OSD assignment where he directed the Commercial Technology Insertion Program, the Commercial Operating and Support Savings Initiative, and the Department's Title III industrial base investments. Dr. McGrath holds a BS in Space Science and Applied Physics and an MS in Aerospace Engineering, both from Catholic University, and a doctorate in Operations Research from George Washington University.

**A. Galip Ulsoy, [NAE]** is the William Clay Ford Professor of Manufacturing, and the Director of the Ground Robotics Research Consortium, at the University of Michigan (UM), he is also a BMED board member. He received the Ph.D. in Mechanical Engineering (ME) from University of California at Berkeley, the M.S. degree in ME from Cornell University, and the B.S. degree in Engineering from Swarthmore College. He served as the Chair of the ME Department and the founding Deputy Director of the Engineering Research Center for Reconfigurable Manufacturing Systems. He served as the Technical Editor of the ASME Transactions J. Dynamic Systems, Measurement & Control, and as the Director, Civil and Mechanical Systems Division, National Science Foundation. Dr. Ulsoy has made basic research contributions to the mechanics of axially moving elastic systems (e.g., translating bands, rotating shafts), and to control system design (e.g., adaptive control, state derivative feedback, coupling between modeling and controller design, time-delayed systems) as well as major research contributions to manufacturing systems (e.g., sawing, turning, milling, drilling, robotics, stamping), automotive systems (e.g., accessory drive belts, active suspensions, vehicle lateral control), and other engineering systems (e.g., disk drives, mineral processing operations). He is co-author of a textbook, over 300 articles, is a co-inventor on 3 patents, and has been a principal investigator, or co-principal investigator, for research projects funded at over \$90 million. Dr. Ulsoy received the 1979 Wood Award from the Forest Products Research Society, a Society of Manufacturing Engineers (SME) 1986 Outstanding Young Manufacturing Engineer Award, the American Automatic Control Council's 1993 O. Hugo Schuck Best Paper Award, a 1995 South West Mechanics Lectureship, a 1997 Service Excellence Award from the College of Engineering at UM, the 2003 Rudolf Kalman Best Paper Award from the J. Dynamic Systems, Measurement and Control, a 2002 Leadership Award, a 2004 Henry M. Paynter Outstanding Investigator Award from the Dynamic Systems and Control Division of American Society of Mechanical Engineers (ASME), and a 2008 Albert M. Sargent Progress Award from SME. He is a member of the National Academy of Engineering and is a Fellow of both the ASME and SME.

**David J. Nash, CEC, USN (retired) [NAE]**, has over four decades of experience in building, design and program management for both the U.S. Navy and the private sector, and is a BICE board member. His experience includes the management of multi-billion dollar physical asset programs, including the U.S. Navy's shore installations worldwide and the reconstruction of Iraq's infrastructure. Under his direction, these organizations managed the \$18.4 billion Iraq infrastructure reconstruction program. He currently serves as president of Dave Nash & Associates, LLC, a company focused on project development and execution in emerging markets and the United States. Mr. Nash's service in the U.S. Navy spanned thirty-three years as an officer in the Civil Engineer Corps (CEC). Among his many leadership positions, Nash served at the top of the CEC as Commander, Naval Facilities Engineering Command and Chief of Civil Engineers. In this capacity, he led a 20,000-person organization responsible for the design, construction and maintenance of the U.S. Navy's shore installations worldwide, as well as leadership over the Navy's 2,000 military engineers. In the private sector, Nash has extended his leadership over large building programs in a variety of executive positions. Upon retiring from the Navy, Nash served as Program Director, Parsons Brinkerhoff, for a one billion dollar renovation program of General Motors' Warren Technical Center Campus in Warren, MI, the centerpiece of which-the renovation of a 2.2 million gross square feet vehicle engineering facility-won three major industry awards. He later established a new company for Parsons Brinkerhoff, PB Buildings, which provided facilities life-cycle services for private sector facilities. Nash is the recipient of numerous awards, including the Society of American Military Engineers Golden Eagle Award, the Beavers Award for Heavy Engineering Construction, the ASCE John I. Parcel-Leif J. Sverdrup Award for Civil Engineering Management, and the CERF/IEEC Henry L. Michel Award for Industry Advancement of Research. In 2005, Nash was named "One of the 50 Top

Newsmakers" by Engineering News-Record. He was elected to the National Academy of Construction in 2003.

**E. Sarah Slaughter** is a Senior Lecturer and Sustainable Lab Coordinator at MIT's Sloan School of Management, and a BICE board member. Her research focuses on sustainable and disaster-resilient infrastructure. From 1999 through 2007, Dr. Slaughter founded and operated MOCA Systems, Incorporated, a technology firm that developed a construction simulation software system. Prior to establishing MOCA Systems, Dr. Slaughter was an Assistant Professor in the Department of Civil and Environmental Engineering at Massachusetts Institute of Technology where her research and teaching interests focused on construction engineering and management; building system design and construction; construction innovation; and computer-aided process simulation of construction activities. Dr. Slaughter was named a National Academy Associate for her service on the NRC Panel on Building and Fire Research, the Committee on Outsourcing Design and Construction Management Services for Federal Facilities, Committee for Infrastructure Technology Research Agenda and the BICE (1998-2001; 2007-2010). She earned an S.B. in Civil Engineering and Anthropology, S.M. in Technology Policy, and a multidisciplinary Ph.D. in the Management of Technology from the Massachusetts Institute of Technology, Departments of Management and Civil Engineering. Dr. Slaughter is a member of Sigma Xi, National Society of Professional Engineers, the American Society of Civil Engineers, the American Society for Engineering Education, and the New York Academy of Sciences. Dr. Sarah Slaughter, Senior Lecturer in the MIT Sloan School of Management, coordinates the Sloan Sustainability Initiative, co-teaches "Strategies for Sustainable Business" and manages the Sustainable Business Laboratory (S-Lab).

She is also a member of the High Performance Building Council Cost Committee in the National Institute of Building Sciences (NIBS), the Sustainability Committee in the International Facilities Management Association (IFMA), the Aging Infrastructure Committee for the ASME Innovative Technologies Institute, and the Inter-Agency Working Group on Climate Change Impacts. She also serves on several editorial boards of professional publications.

**Jesus M. de la Garza** is the Vecellio Professor of Construction Engineering and Management in the Charles E. Via Jr. Department of Civil and Environmental Engineering at Virginia Tech, and a BICE board member. Dr. de la Garza has been on the staff of Virginia Tech since 1988. His areas of interest and courses taught include information technology, construction engineering and management, design-construction integration, knowledge-based expert systems, construction performance improvement, cost engineering, and professional and legal issues in engineering. From January 2004 to August 2006, Dr. de la Garza served as the director of Information Technology and Infrastructure Systems program within the Civil and Mechanical Systems Division at the National Science Foundation. He has co-authored more than 40 papers in refereed publications and has received awards for several of his papers. Dr. de la Garza has been an officer on the American Society of Civil Engineers (ASCE) Intelligent Computing Committee. He received his MS and PhD in civil engineering from the University of Illinois. de la Garza helps spearhead a course that brings industry professionals from such companies as Bechtel, Fluor, duPont, Procter & Gamble, and KBR to Virginia Tech's Blacksburg campus to educate students on the best practices being incorporated into the construction field. de la Garza specializes in construction engineering and highway infrastructure management and is a member of the Virginia Tech's Myers-Lawson School of Construction. As director of CHAMPS (Center for Highway Asset Management ProgramS) he has led efforts to identify innovative ways to measure the effectiveness of the performance-based road maintenance contracts that the Virginia Department of Transportation awards. The evaluation for effectiveness focuses primarily on the physical level of service of the interstate. He has also served as program director of the Information

Technology and Infrastructure Systems program for the National Science Foundation's Civil and Mechanical Systems Division, and as co-chairman of the academic committee of the CII. He earned his bachelor's of science in civil engineering from Tecnologico de Monterrey in 1978, and his master's and Ph.D. degrees in civil engineering from University of Illinois in 1984 and 1988, respectively.

## **Appendix 3**

### **Agendas from meetings**

# **AGENDA OPEN SESSION**

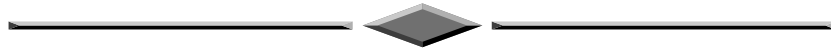
## **Defense Materials Manufacturing and Infrastructure (DMMI)**

**(A NMAB Standing Committee)**

### **Meeting 1**

**November 4-5, 2010**

Washington, D.C.  
The Keck Center .



# Thursday, Nov. 4, 2010

*The meeting Room, K206*

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**OPEN SESSION** *Committee, NRC Staff, Sponsors and Guests*

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<i>11:00 a.m. – 11:30 a.m.</i>	<b>Introduction and Discussion of our Task</b> Dr. Robert Latiff, <i>Chairman</i>
<i>11:30 a.m. – 12:30 p.m.</i>	<b>DOD and Reliance Overview</b> Dr. Lewis Slotter, <i>Associate Director of Materials and Structures, Office of the Deputy Under Secretary for Science and Technology and Weapon Systems. And,</i> Mr. Robert Rapson, <i>WPAFB</i>
<i>12:30 p.m. – 1:30 p.m.</i>	<i>Lunch</i>
<i>1:30 p.m. – 3:00 p.m.</i> <b>Discussion</b>	<b>Presentations by Standing Committee Members and</b> Dr. Robert Latiff, <i>Chairman,</i>
<i>3:00 p.m. – 3:15 p.m.</i>	<i>Break</i>
<i>3:15 p.m. – 4:30 p.m.</i> <b>Discussion</b>	<b>Presentations by Standing Committee Members and</b>  <b>Cont'd</b> Dr. Robert Latiff, <i>Chairman,</i>
<i>4:30 p.m. – 5:00 p.m.</i>	<b>Wrap-up</b> Dr. Robert Latiff, <i>Chairman,</i>
<i>5:00 p.m.</i>	<i>Adjourn</i>

## Friday, Nov. 5, 2010

*The meeting Room, K206*

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**OPEN SESSION** *Committee, NRC Staff, Sponsors and Guests*

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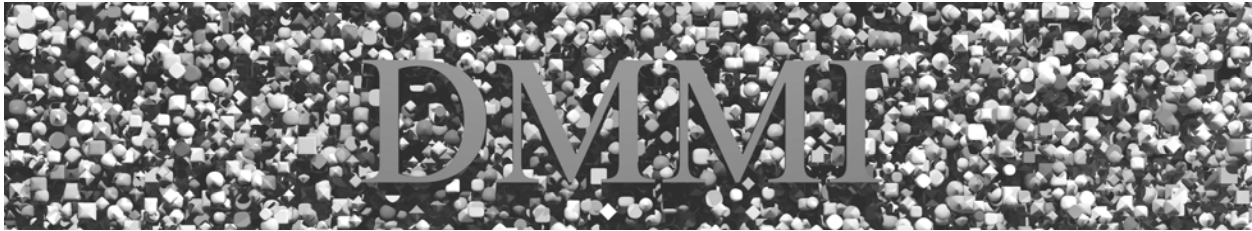
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<i>8:00 a.m. – 8:30 a.m.</i>	<i>Breakfast available</i>
<i>8:30 a.m. – 8:45 a.m.</i>	<b>Welcome and Opening Remarks</b> <i>Dr. Robert Latiff, Chairman</i>
<i>8:45 a.m. – 10:15 a.m.</i>	<b>Open Discussion Generation of Topics</b> <i>Dr. Robert Latiff, Chairman</i>
<i>10:15 a.m. – 10:30 a.m.</i>	<i>Break</i>
<i>10:30 am – 12: 00 p.m.</i>	<b>Planning for Future Meetings</b> <i>All</i>
<i>12:00 p.m. – 1:00 p.m.</i>	<i>Lunch</i>
<i>1:00 p.m.</i>	<i>Adjourn (closed session begins, Committee and staff only)</i>

# **AGENDA**

## **[Committee and Staff Only]**

### **Defense Materials Manufacturing and Infrastructure (DMMI)**

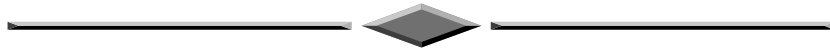


**(A DEPS Standing Committee)**

#### **Meeting 2**

**March 31 – April 1, 2011**

Washington, D.C.  
The Keck Center



#### **Meeting Objectives**

##### **Discussions on Materials and Manufacturing Sustainability**

This meeting includes infrastructure considerations, efficient and green processing and manufacturing aspects as well as materials availability. Focus is on materials availability problems, critical minerals, rare earths, substitution, recycling etc., materials processing capabilities, shortcomings etc., manufacturing and infrastructure. Spanning 1&1/2 days.

# Thursday, March 31, 2011

*The meeting Room, K101*

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## CLOSED SESSION

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8:00 a.m. – 8:30 a.m.      *Working Breakfast*

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## OPEN SESSION

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8:30 a.m. – 9:05 a.m.      ***Welcome, what is DMMI and Opening Remarks***  
Dr. Robert Latiff, *Chairman*

9:05 a.m. – 9:30 a.m.      ***Assessing the Criticality of Metals***  
Dr. Thomas E. Graedel, Professor of Industrial Ecology, Center for Industrial Ecology, Yale University

9:30 a.m. – 9:55 a.m.      *Q&A period*

9:55 a.m. – 10:10 a.m.      *Break*

10:10 a.m. – 10:35 a.m.      ***The Rare Earth Crisis –  
The Supply / Demand Situation for 2010-2015***  
Dr. Karl A. Gschneidner, NAE, Anson Marston Distinguished Professor and Senior Metallurgist, Ames Laboratory

10:35 a.m. – 11:00 a.m.      *Q&A period*

11:00 a.m. – 11:25 a.m.      ***OSTP's view on Defense related Materials, Manufacturing and Infrastructure issues***  
Mr. Philip E. Coyle III, Associate Director for National Security

and  
International Affairs, Office of Science and Technology Policy

11:25 a.m. – 11:50 a.m.      *Q&A period*

11:50 a.m. – 12:50 p.m.      *Lunch*

12:50 p.m. – 1:15 p.m.      ***An Industry Perspective on Plant Processes, Licenses, Permits, etc.***

Mr. Andy Davis, Manager of Public Affairs, Molycorp, Inc.

1:15 p.m. – 1:40 p.m.      *Q&A period*

1:40 p.m. – 2:05 p.m.      ***Rare Earth Materials***  
Dr. Cyrus Wadia, Senior Policy Analyst - Renewable Energy, Office of Science and Technology Policy

2:05 p.m. – 2:30 p.m.      *Q&A period*

2:30 p.m. – 3:00 p.m.      ***Summary Comments***

Dr. Robert Latiff, *Chairman*

3:00 p.m. – 3:15 p.m.

*Break*

3:15 p.m. – 4:30 p.m.

***DMMI planning session***

Dr. Robert Latiff, *Chairman*

4:30 p.m.

*Adjourn*

5:00 p.m.

*Dinner, DMMI standing committee members*

## Friday, April 1, 2011

*The meeting Room, K101*

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### CLOSED SESSION

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8:00 a.m. – 8:30 a.m.

*Working Breakfast*

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### OPEN SESSION

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8:30 a.m. – 8:40 a.m.

***Welcome and Opening Remarks***

Dr. Robert Latiff, *Chairman*

8:40 a.m. – 9:05 a.m.

***Open Manufacturing***

Dr. Leo Christodoulou, Director, Defense Sciences Office,  
Defense Advanced Research Projects Agency DARPA

9:05 a.m. – 9:30 a.m.

*Q&A period*

9:30 a.m. – 9:55 a.m.

***Impact of Environmental Efforts in Consumer Electronics on  
Defense Electronics***

Dr. Robert Pfahl, Vice President of Global Operations,  
International Electronics Manufacturing Initiative, Inc. (iNEMI)

9:55 a.m. – 10:20 a.m.

*Q&A period*

10:20 a.m. – 10:35 a.m.

*Break*

10:35 a.m. – 11:00 a.m.

***Critical materials, rare earths, and infrastructure systems***

Dr. Sarah Slaughter, Associate Director for Buildings and  
Infrastructure, MIT Energy Initiative, Massachusetts Institute  
of Technology

11:00 a.m. – 11:25 a.m.

*Q&A period*

11:25 a.m. – 12:15 a.m.

***Open Discussion and Summary Comments***

Dr. Robert Latiff, *Chairman*

—◆— **CLOSED SESSION** —◆—

*12:15 p.m. – 1:15 p.m.      Lunch*

—◆— **OPEN SESSION** —◆—

*1:15 p.m. – 3:15 p.m.      **DMMI planning session**  
Dr. Robert Latiff, *Chairman**

*3:15 p.m.      Adjourn*

## Appendix 4

### Initial project descriptions

Below are the individually suggested topics for future DMMI meetings. These were prepared for discussion purposes only, they have not been reviewed. The views expressed do not necessarily reflect the views of the National Research Council or the standing committee on Defense Materials, Manufacturing and Infrastructure (DMMI) as a whole.

### *Suggested Topics:*

#### Resilient and Sustainable Installations – CONUS and FOB

*Leads: Denise Swink, Sarah Slaughter, Valerie Browning, Jesus de la Garza*

#### Aviation Biofuels

*Leads: Denise Swink, Mike McGrath, Valerie Browning*

#### 21<sup>st</sup> Century Smart Manufacturing

*Leads: Denise Swink, Mike McGrath*

#### 21<sup>st</sup> Century Paradigm Change in Performance and Design Metrics

*Leads: Denise Swink*

#### Materials and Manufacturing Sustainability

*Leads: Bob Latiff, Mike McGrath, Bob Schafrik*

#### Information Framework for ICME

*Leads: Mike McGrath, Steven Wax, Bob Schafrik*

#### Materials and Manufacturing Sustainability

*Leads: Bob Latiff, Mike McGrath, Bob Schafrik*

#### Ultra-strong Molecules – Fact, Fiction and the Future

*Leads: Haydn Wadley, Valerie Browning, Steven Wax*

#### Title: Assessing Plans to Exploit Nanoelectronics for DOD

*Leads: Thomas Hartwick and Valerie Browning*

Innovation Capacity for DOD MMI – From Invention to Deployment  
*Leads: Sarah Slaughter, Denise Swink, Valerie Browning*

## **Title: Resilient and Sustainable Installations – CONUS and FOB**

**DMMI Committee Leads:** Denise Swink, Sarah Slaughter, Valerie Browning, Jesus de la Garza

While development and sustainability of weapons platforms have historically been emphasized by DOD, there is a growing awareness of the pressing need to turn the same technology focus on Continental US (CONUS) and Forward Operating Bases (FOB) to make them more resilient and sustainable. CONUS operations have become critical beyond their traditional mission (i.e., training, support and readiness of troops and military operations) to include extension of nation infrastructure support during major disruptions and as a critical component of theater operations from thousands of mile away. Their operations are engulfed in a legacy infrastructure of well of 30 years old, with little “new” build planned in the foreseeable future. FOB must create a “new world” infrastructure in hostile environments to take advantage of technological assets and capabilities necessary for their mission success. These installation challenges, domestic and abroad, call for the same level of innovative technological insertion as has been emphasized in weapons platforms. DOD cannot rely completely on what the “commercial” establishment has to offer, financially or technically.

Because priorities and needs are very different for CONUS or FOB, two sessions should be setup to begin to address what could and should be done to pursue opportunities in new material development, material fabrications and manufacturing, and infrastructure deployment designs and practices leading to more resilient and sustainable operations. Opportunities should integrate across outcomes including: improved energy efficiency and availability; enhanced water quality, delivery efficiency and availability; strengthened environmental sustainability; and elevated infrastructure performance, maintenance and resilience.

The output of each session would: a) describe current shortcomings in resilience and sustainability; and b) create an agenda of priority topics to drill into for near-, mid-, and long-term action. Ultimately, a prioritized R&D program for technology insertion would evolve.

### **Desired participants:**

#### *CONUS*

Ken Eickmann, U Texas, Energy for Mission Critical Capabilities, Air Force sponsored study

William Harrison, AFRL, principal, EMC2 study

Jim Bartis, Rand Corporation, recent comprehensive Army installation study

Dr. Dorothy Robyn or John Conger, OSD Installation Energy, Etc.

#### *FOB*

Sharon Burke, OSD Operations Energy

Etc.

## **Title: Aviation Biofuels**

**DMMI Committee Leads:** Denise Swink, Mike McGrath, Valerie Browning

The Air Force and the Navy have near term targets (2016/2017) to adopt 50/50 blend aviation biofuels in their aircraft. Certification of aircraft is well in hand and is expected to be complete ahead of those targets. The commercial aviation industry has been working closely with the Air Force for several years, and is very close to the same timing of readiness. The major challenge is that of availability of the domestic production capacity of biojet fuels. While the current DOD thinking is to not be a developer of fuel, but create the industry through demand, there may be an important role for DOD to play technologically to assist the industry in smoothing out “rough edges” of initial production. For example, if DOD chooses to use Defense Production Act, Title III authority to stimulate initial plant production capacity, that authority also allows for those plants to have an R&D capacity to explore changes in materials, components and feedstocks which can improve operational parameters, fuel flexibility and costs. A technology insertion role to help raise the viability of the aviation biofuels industry seems and appropriate consideration for Reliance.

An awareness session should be organized with briefings by the Air Force, Navy and Commercial Aviation Alternative Fuels Initiative (CAAFI). Department of Agriculture could explain their assistance programs, and Department of Energy their technology development programs. Federal Aviation Administration could explain their programs to encourage widespread use of aviation biofuels. They all have fairly robust roadmaps covering all aspects of R&D, deployment, certification and commercialization which could be summarized. Challenges/issues/opportunities should be shared. The question would be posed to each participant – if DOD were to have a technology insertion role to assist the viability of the initial plants, where should it focus?

With the output from the awareness session, DMMI Committee would then make recommendations to Reliance of, if viable, a prioritized list of programs for technology insertion during initial production periods.

### **Desired participants:**

- Air Force, Navy, CAAFI, DOA, DOE, FAA, National Center for Food and Agriculture Policy, DESC, Army
- Participation from airframers (Boeing, Lockheed) and engine OEMS (GE, PW, RR)

## **Title: 21<sup>st</sup> Century Smart Manufacturing**

**DMMI Committee Leads:** Denise Swink, Mike McGrath

Integrating intelligence into manufacturing is on the cusp of a leap-frog advancement. Sensors integrated with intelligent processing have been applied in large manufacturing operations for decades; and, enterprise-wide management systems, e.g., SAP, have been also. However, advancements in smart materials, miniaturization, sensing, cloud computing, etc., is about to revolutionize the way manufacturing is done – from plant and product design, through materials handling and processing, through manufacturing and distribution, through supply chains and customer interfaces. No longer will any operations be “discrete” – everything will be linked, intelligent, reactive, healing, learning and informative. It is important for DOD to be on the forefront of awareness and participation in this world-wide wave. (The EU is investing \$1.2 billion euro’s currently in smart manufacturing technology development and insertion programs, and developing countries have growing programs.) DOD’s supporting materials and manufacturing base, to be and stay globally competitive, must capture the anticipated smart manufacturing outcomes which include: 8 fold reduction in costs; 10 fold reduction in time to commercialization; 80% reduction in maintenance costs; 10% increase in operating efficiency; 25% reduction in safety incidents; and 25% gain in energy efficiency.

An awareness session should be organized hosting the variety of organizations pursuing Smart Manufacturing to share where their programs stand, where they plan to move to, and how they see that relating to DOD’s missions. A second, focused session would pin point the particular opportunities to fill materials processing and manufacturing needs to strengthen DOD’s supply chain’s ability to take the strongest advantage of the benefits of the Smart Manufacturing outcomes, integrating with the breath of other efforts.

The output of the awareness session would be a summary hand book for reference of programs and contacts. The output of the focused session would be recommendations of R&D programs to be considered by Reliance.

### **Desired participants:**

- Jim Davis, UCLA, Smart Manufacturing Leadership Coalition
- National Center for Manufacturing Sciences
- NSF
- Industrial Technology Program, Energy Efficiency and Renewable Energy, DOE
- Manufacturing Lab, NIST, and the Manufacturing Extension Partnership program
- OSTP
- Manufacturing Czar’s Office

## **Title: 21<sup>st</sup> Century Paradigm Change in Performance and Design Metrics**

**DMMI Committee Leads:** Denise Swink

Materials, components, processes and systems continue to be developed to performance and design metrics from the 1960's or even before that. For example, optimizing longevity to decrease capital investment needs and minimizing need for inventory turnover have been driving factors. What DOD is left with is an aging, legacy infrastructure and systems which are “de-modernizing” due to their lack of ability to integrate technological advances at current (and more rapid anticipated) state-of-the-art pace.

A session should be sponsored inviting DDR&D and the Services to share performance and design metrics they are currently using for materials, components, processes and systems development. Then an examination should be made of what current performance and design metrics may impede technological insertion and advancement, with recommendations on how they should be changed, deleted or added to. Suggestions of timing and methods of rolling the “new” paradigm out should also be made by the Committee.

The outcome could be a new manual – 21<sup>st</sup> Century Performance and Design Metrics – that could be shared and used through out the Reliance Community.

### **Desired participants:**

- DDR&D
- Services
- DARPA

## **Title: Materials and Manufacturing Sustainability**

**DMMI Committee Leads:** Bob Latiff, Mike McGrath, Bob Schafrik

The National Defense Stockpile was originally designed to hold those materials deemed to be necessary for US weapons manufacturing in time of national emergencies and which were not deemed to be in sufficient supply or availability. Over the years, the global economic and national security situations have changed dramatically, but the DOD approach to critical and strategic materials availability has not kept pace. In addition, the ability of US industry and the defense industrial base to process the materials and manufacture products necessary for Defense has dramatically contracted.

The goal of this focused session would be to determine those materials most critical to the Department of Defense, assess the ability of the US to obtain and process those materials into usable forms, and assess the ability of industry to manufacture critical defense items. Specific goals of the session would include:

- Determine the list of materials most critical to DOD systems and operations
- Assess the current and potential future availability of the listed materials to include recycling
- Assess the processing capability of the US for the listed materials (including extraction from recycled goods and/or landfill recovery)
- Assess opportunities for reducing the environmental footprint for the refining of critical minerals. DARPA's program on Meltless Titanium is an example of new chemical engineering approaches that eliminate the costly, dirty process of making titanium sponge.
- Assess potential alternative/substitute materials
- Assess the DOD knowledge base in the science of the listed materials and processes
- Determine the adequacy and consistency of legislation, policy, and regulations governing the strategic materials and manufacturing capabilities important to DOD

The output of this focused session would be a) a more detailed and generally accepted understanding of the materials, manufacturing, and expertise issues facing the DOD in its system acquisition and sustainment and b) an outline for a future major study on DOD alternatives.

**Desired participants:** might include DMMI Standing Committee members, Reliance principals, and the following:

- Dave Sandalow, DOE, Dave Cammarota, DOD, Rick Lowden, ORNL
- Congressional Staff, OSTP, and USGS
- James McGuffin-Cawley, Case Western Reserve
- Defense Production Act management, Recycling Assoc/Orgs, and

## **Title: Information Framework for ICME**

**DMMI Committee Leads:** Mike McGrath, Steven Wax, Bob Schafrik

The 2008 NRC report on Integrated Computational Materials Engineering calls for automated tools to access and update materials databases, science-based processing/structure/property codes designed for integration and interoperability, a protocol for translating data and models into ICME tools, materials taxonomies and imaging standards, and an open access integration and collaboration platform for model development. An information framework is needed to tie together development efforts that will be nationally and internationally distributed and developed over a decade or more.

The goal of this workshop would be to review examples of large data sharing problems in other domains, and to identify the information architectures, standards categories and lessons learned that will be important to achieving ICME objectives. Specific objectives of the workshop discussions would include:

Reviewing the informatics needs of ICME

Examining the approaches to large scale information integration used by other application domains, such as the DoD System 2020 initiative, Large Data Joint Concept Technology Demonstration (JCTD), NetCentric Warfare, Joint Mission Environment Test Capabilities (JMETC), the Human Genome Project and other curated data bases, Healthcare Informatics, 3D CAD and Simulation vendors, Enterprise Resource Planning (ERP), and emerging commercial Cloud Computing services.

Identifying key features of the general information framework needed for modular development and loosely coupled integration of ICME capabilities and information.

Identifying current research and development programs (e.g., universities, labs, companies) focused on characterization and cataloguing of materials, and emerging state of knowledge.

The output of this focused session could feed into a larger, long-term study that would develop recommendations on development and implementation of the standards and information architecture needed by the ICME community.

**Desired participants:** would include the DMMI Committee members, Reliance principals and the following:

- A Reliance perspective on ICME Informatics needs
- A DoD panel on S2020, Large Data, NetCentric Warfare and JMETC
- A panel on Human Genome project and Healthcare Informatics
- Commercial vendors of CAD, engineering simulations, and cloud computing
- NIST and other experts in standards and information architectures

## **Title: Ultra-strong Molecules – Fact, Fiction and the Future**

**DMMI Committee Leads:** Haydn Wadley, Valerie Browning, Steven Wax

Strong molecules based upon aromatic polyamides (para-aramids), ultra high molecular weight polyethylene, poly-p-phenylenebenzobisoxazole (PBO) and polyhydroquinone-diimidazopyridine (M5 fiber) are of great technological importance and are widely used by the DOD for ballistic protection systems. Recent discoveries of various (carbon, boron nitride etc) nano tubes, graphene and proposals to fashion these molecules in fiber forms purportedly hold promise for even higher specific strength systems. Ceramic fibers made of graphite, diamond, silicon carbide, alumina, and boron are also revolutionizing composites. High temperature (ceramic matrix) composites based upon silicon carbide (high Nicalon) are the foundation of future increases in the performance of military gas turbine engines. However, these technological advances have progressed faster than our fundamental understanding of the factors that control their mechanical response. For example, the strength of ultrahigh molecular weight polyethylene is less than 50% that required to break the covalent c-c backbone thus implying that some other mechanism is strength controlling (and the potential for a doubling of strength for no increase in weight). As a consequence, synthesis and processing is an empirical, slow and costly development process and much of the core technology now resides outside the United States.

The goal of this focused workshop would be to develop and objectively assess the most promising opportunities for the strong molecules and fibers of the future. It would review the various government and industrial development efforts, compare the performance of the emerging systems and assess the scientific tools that need to be developed to understand the complex relationships between molecule properties, meso-scale structure, synthesis/processing and fiber performance in ballistic and high temperature applications. The goal is to identify a US research and development agenda that could lead to a restoration of a national capability that once again leads the world.

**Desired participants:** would include the DMMI Committee members, Reliance principals and the following:

- Leo Christodoulou, DARPA
- David Shifler, ONR
- Leaders from the fiber fabrication industry
- Members of the user community (e.g Phil Cuniff (Natick Soldier Center))
- Academic experts (e.g Professor Ned Thomas (MIT))

## **Title: Assessing Plans to Exploit Nanoelectronics for DOD**

### **DMMI Committee Leads: Thomas Hartwick and Valerie Browning**

To set the stage for this suggested activity, we can relate our technology state for nanoelectronics to that of the Liquid Crystal Display (LCD) in the 1980s. While several companies had developed basic LCD prototypes, it was IBM who took the bold step to create an Asian partnership for manufacturing commercial products. With this partnership, the U.S. failed not only in its attempt to re-claim cockpit display production (~\$100M DOD investment) but also in the broader efforts to re-constitute a US production base. Thus, an entire U.S. based industry opportunity was lost. The hope is that we can avoid a similar situation for nanoelectronics through careful assessment and planning.

This activity would assess nanoelectronics technology and provide insight into the current status of nanoelectronics important to the DOD as well as plans for establishing appropriate US production. Keeping in mind that either lack of action (example: LCD) or premature action (example: SiC) can lead to undesirable results, this assessment must be objective and realistic. Further, the assessment must differentiate between commercial products which would not directly impact DOD (but which would probably nucleate an off-shore production base) and DOD specific products which would be produced in far lower quantities than commercial products. This situation is somewhat analogous to ASIC chip production for current DOD systems where procurements are split between products produced in commercial foreign plants and those produced in a “trusted foundry” U.S. plant at great expense.

To obviate the problems associated with scanning the plethora of device literature world-wide, this assessment would rely on device successes already identified as beneficial to the DOD. One example is the development of SWNT field emission cathodes for high power microwave (HPM) applications such as DEW and low noise traveling-wave tubes for satellite communications. Both SWNT and Graphene structures have also been discussed for other high performance nanoelectronics DOD applications and the scope as contemplated would not include quantum dots or strained layer superlattice structures.

Two important aspects of this assessment will be the development of improved tools for creating device structures and the innovations needed to carry these tools forward to the manufacturing floor. It is arguable that the entity that develops better tools will create better products faster.

A workshop to explore this topic would have these objectives:

- Establish the current state of nanoelectronics for DOD applications.
- Prioritize the “high performance merit” of specific nanoelectronic devices.
- Assess field emission cathodes to enable TWT/HPM systems for IED negation.
- Explore whether it makes sense to accelerate manufacturing process and tool development.
- Explore whether consideration should be given to establishing a pilot line in a government facility.

### **Possible Participants:**

Dr. S. Fairchild (AFRL), Dr. T. Theis (IBM), HP group, Sandia group, NIST group

## **Title: Innovation Capacity for DOD MMI – From Invention to Deployment**

**DMMI Committee Leads:** Sarah Slaughter, Denise Swink, Valerie Browning

The DMMI committee is charged with considering the transfer of relevant technologies to the commercial sector as appropriate, including “assessing the critical availability and timeliness of the processes that provide defense materials, parts, and products.” The committee discussed the existing and needed capacity in the U.S. to develop and commercialize important new developments in materials, manufacturing and infrastructure for DOD mission and operations, particularly for important emerging areas.

In 2009, the U.S. Congress asked the National Academies to assess the impact of the SBIR program on the commercialization of innovations<sup>1</sup>, particularly for DOD, NASA, NIH, DOE, and NSF. That committee concluded that the DOD SBIR was effective at enabling the commercialization of important developments, but that a significant – and potentially terminal – gap existed between the proof of concept and the viability of commercial operations.

The proposed session “Innovation capacity for DOD MMI” would focus on existing and potential new programs and initiatives that respond to the recommendations of the NRC committee and other (non-SBIR) commercialization efforts, focusing specifically on the capacity to commercialize innovations associated with DOD materials, manufacturing and infrastructure interests. For instance, DMMI areas could concentrate on pilot programs, linkages to ManTech, and procurement policies that build on the interdependence of these three fields - such as the use of novel materials with new manufacturing processes for bridge construction (for both DOD field operations and for domestic facilities). The session could focus on specific “case studies” on what has (or has not) worked in the commercialization of critical advances for DOD, inviting the case study companies to present to the committee and DOD members.

The output of this focused session could develop into program initiatives and policy by DOD and the services to enhance commercialization of DMMI innovations. Depending on the results of the session, a follow-on workshop or study could address potential strategic gaps in US materials, manufacturing and infrastructure systems related to these commercialization efforts.

**Desired participants:** would include the DMMI Committee members, Reliance principals and the following:

- Members of NRC committee that reviewed DOD SBIR program, and its director
- Charles Wessner from the NRC committee on US and Japan commercialization
- Manufacturing Extension Partnership/DOC Director
- Nabil Nasr of Rochester Technology Inst.
- Large mentor and case study companies as GE, Caterpillar, Hewlett Packard

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<sup>1</sup> ([http://www.nap.edu/catalog.php?record\\_id=11963#toc](http://www.nap.edu/catalog.php?record_id=11963#toc))